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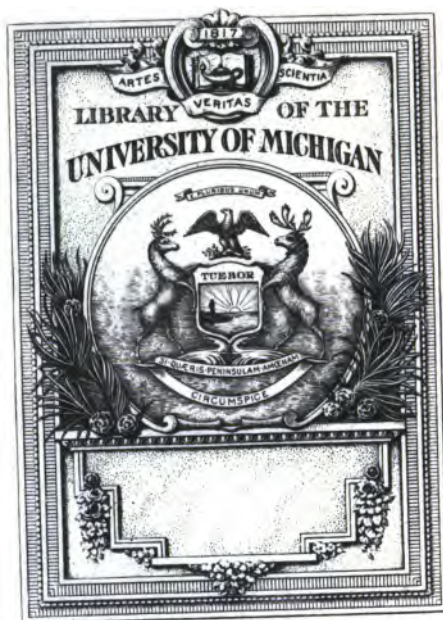
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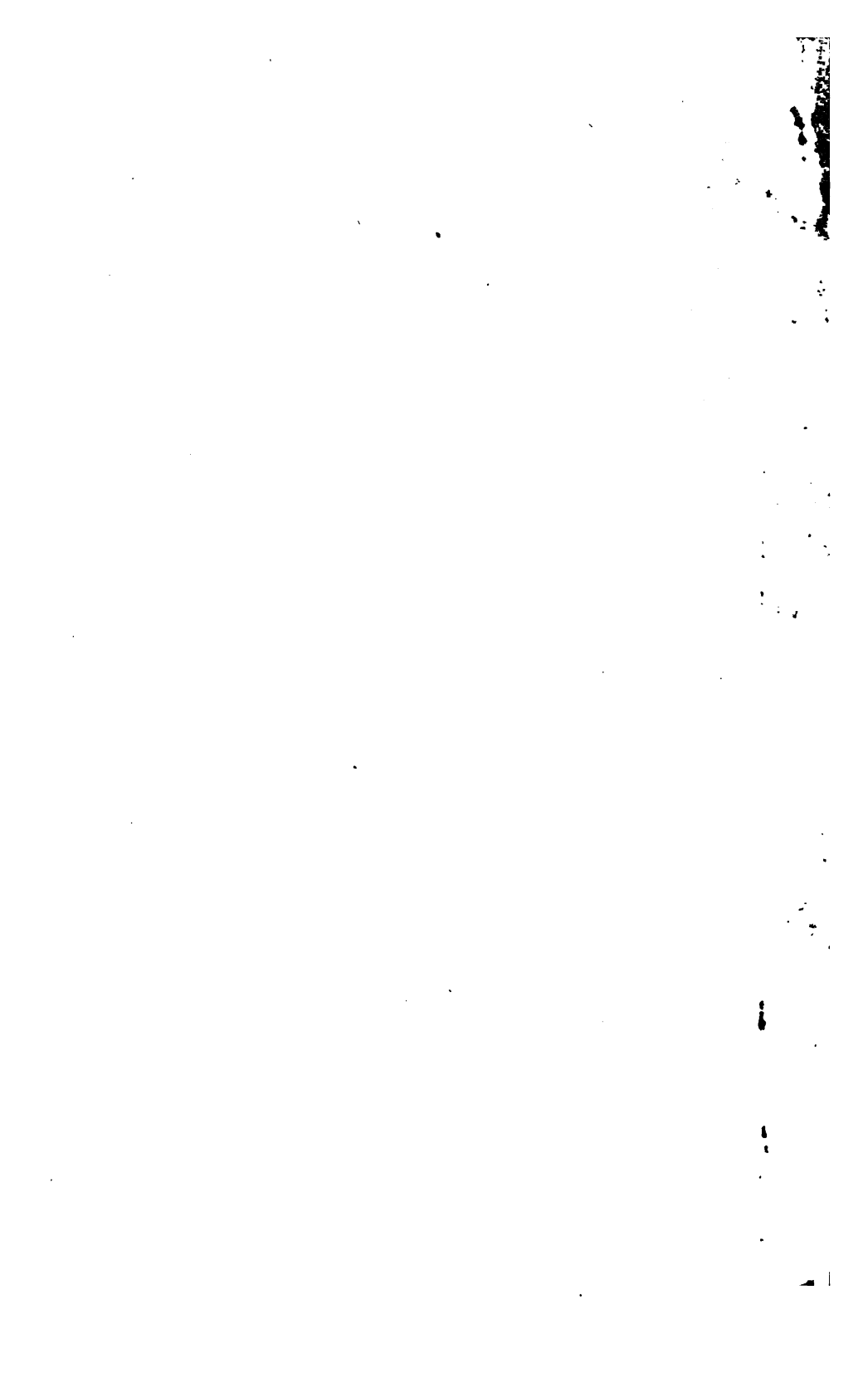
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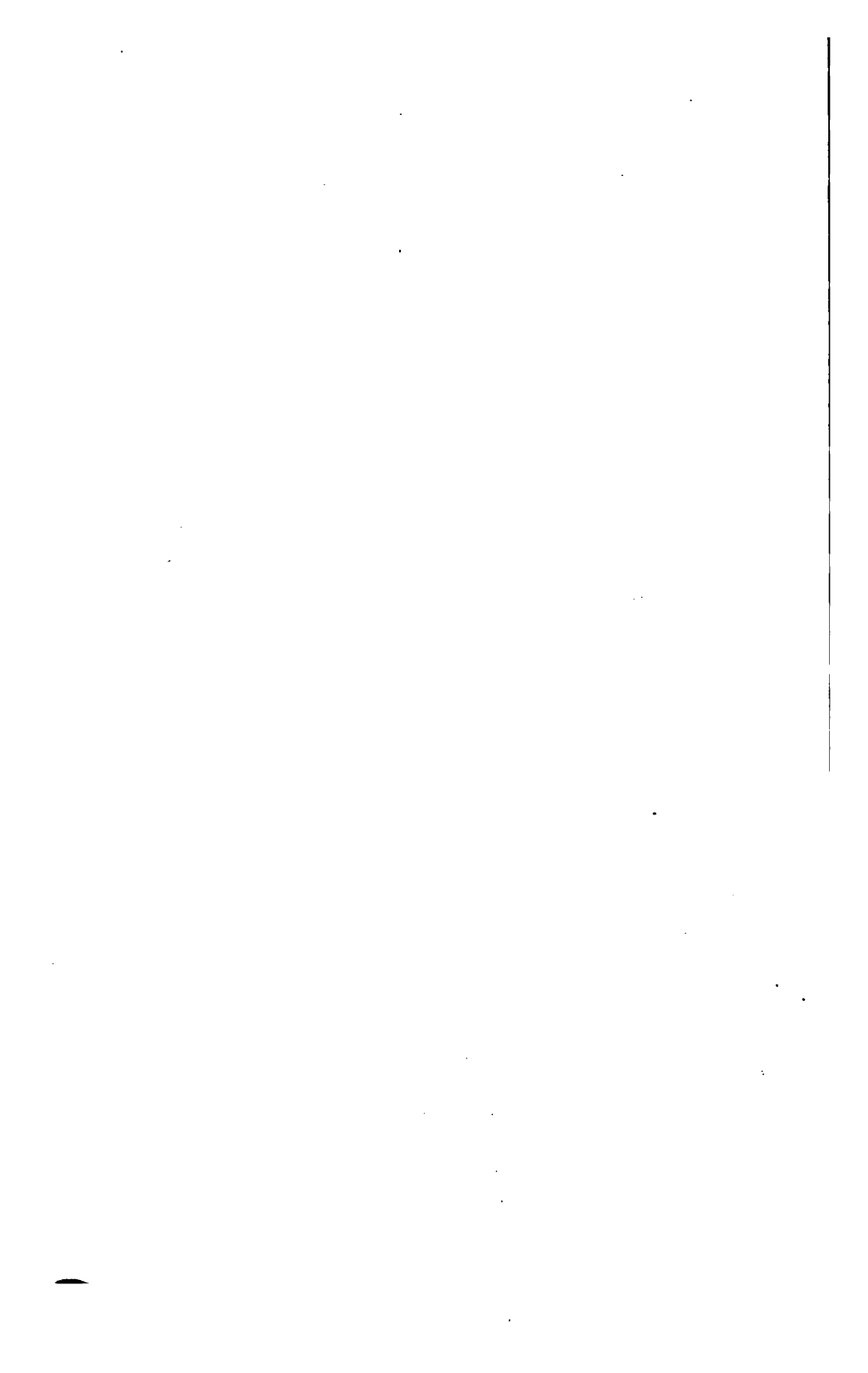
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*International Fisheries Exhibition*

LONDON, 1883

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OYSTER CULTURE

AND

OYSTER FISHERIES

IN

*THE NETHERLANDS*



BY  
*Ambrsius Arnold Willem*

PROFESSOR HUBRECHT

LONDON

WILLIAM CLOWES AND SONS, LIMITED

INTERNATIONAL FISHERIES EXHIBITION

AND 13 CHARING CROSS, S.W.

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*International Fisheries Exhibition.*

LONDON, 1883;

CONFERENCE ON JUNE 29TH, 1883.

OYSTER CULTURE AND OYSTER FISHERIES IN THE NETHERLANDS.

Lord HENRY SCOTT, M.P., took the chair, and in introducing Professor Hubrecht, said this was a subject in which he felt deep interest, and had had some practical experience. Being the owner of a property on which there was a native bed of oysters, this had drawn his attention to the subject, and the importance of, if possible, doing something to restore the stock of oysters upon it, which he found to be deficient. The stock of British oysters was acknowledged to be daily diminishing, there not being enough to meet the ordinary supply, so that recourse was obliged to be had very largely to foreign oysters, and even they were not sufficient to supply the demand for this excellent article of food.

12-14-37 Nom.

Professor HUBRECHT spoke as follows :

About six weeks ago I had the advantage of being present at a lecture "On Oysters and the Oyster Question," which was given at the Royal Institution by one of your most eminent biologists, Professor Huxley.

It would be very presumptuous on my part to go over the same ground once more, after that very able discourse has come under the notice of you all, and I wish to limit

N 0 411

myself to a few statements concerning the oyster fisheries and oyster culture in the Netherlands.

Time was when oysters from natural oyster-beds were very plentiful with us. These beds were situated, partly in our Southern province of Zeeland, partly towards the North in the inland sea which we call the Zuyderzee, at the spots indicated on the Map. The oysters were brought to market in Amsterdam and were partly exported to Germany at a price which bears no comparison at all with what is at present paid for them.

This having been the state of things a good many years ago, it is a pity that we have to recognize the fact of one of these natural beds being nearly destroyed. There is no serious doubt but this destruction has come about by over-fishing. The few oysters that are left are only worth the notice of the Nieuwe-Diep fishermen in the summer time when they are not employed in any other fisheries, and even out of their number only a few pay regular visits to those parts of the Zuyderzee where oysters may happen for the moment to be just a little more numerous than usual. There is no regular oyster trade in that part of the country.

The oyster trade with us is for the present concentrated in the province of Zeeland, where, as was noticed before, a second natural oyster-bed of some extent has existed. This bed was very fast on its way towards extermination and would certainly have followed in the wake of the Zuyderzee beds, had not oyster "culture" at the right nick of time stepped in and replaced "oyster fishing." The already impoverished regions have since made rapid strides towards their maximum of productivity, and it is from them that the large numbers of so-called Dutch oysters or Dutch natives, which if I am not wrong are high up in the scale of



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merit according to the verdict of London palates, are derived.

It was in 1870 that this change of system was effected. Up to that year fishermen from the small village of Yerseke and from other hamlets round the so-called eastern arm of the River Schelde regularly fished and dredged on this bed in the five winter months (October—February). There was a close time for oyster fishing (during which period it was strictly prohibited) of no less than seven months, from March 1 to October 1. Still it was generally accepted that notwithstanding these measures the bed gradually became impoverished.

About the same time that it was decided upon to no longer allow public fishing on these beds but to give them into the hands of oyster-culturists, another important change had been effected in the geographical situation of the oyster-beds. A railway-dam had been constructed across the eastern arm of the Schelde where it was narrowest, and this practically changed the nature of its waters. It now became, as you will see from this map, a deep inland bay, instead of being one of the arms of the Schelde delta through which part of the fresh water from this river could flow towards the German Ocean. This change has of course affected the salinity of the water, and it may be safely inferred that this has not remained without influence on the oyster-beds of the eastern Schelde and their productivity.

The first impulse towards prohibiting public fishing on the so-called Yerseke oyster-bed was given by private gentlemen, who in 1867 had visited the Arcachon oyster regions and who applied to government for aid towards an investigation of the condition of the Yerseke-bed. The result was that in 1870 and 1872 Government, or rather

the Minister of the Finances under whose control are also the fishing waters of the country, withdrew the Yerseke oyster-bed from public fishery and leased it for purposes of oyster-culture to private individuals, after having divided it into plots varying in size from 12 to about 150 acres. The rent was to be paid yearly, and the time up to which it might be retained for the same rent was 15 years, facilities being offered to those who wished to give back their allotted plots before the expiration of the 15 years' term. In 1885 the whole of the Yerseke oyster-bed would come back to Government and new agreements would then be decided upon. As this period is now rapidly approaching it was wisely decided upon by Government not to wait till 1885 before re-letting the bed, but to do so at least three years before the expiration of the present leases. So last year this new leasing took place, and the same 7720 acres which form together the Yerseke oyster-bed and which have been leased from 1870 to 1885 for a yearly rent of about £1720, will in 1885 bring into the Exchequer a yearly amount of £28,765. These figures speak for themselves and go far towards demonstrating that oyster-culture in the regions we are speaking of is a success. The new lease runs for thirty years, with the right on the part of the lessees to give up their allotments every five years.

The extraordinary increase in value just alluded to of the different portions of the oyster-bed, has not similarly affected all portions of that area. I will give you figures to demonstrate this; but I must first call to your mind, that in the practice of oyster-culture, certain areas are principally devoted to "growing" the oysters, others to collecting the spat, and that the value of a certain area is principally determined by the intrinsic qualities which it is supposed to possess for the one or for the other of these operations.

The collection of the spat essentially consists in the process of bringing out into the sea-water tiles, like these I have here on the table, covered by a layer of chalk, which is afterwards easily removed, together with the young oysters adhering to it.

These tiles are brought out in millions at the time when the oyster spat is expected to be most plentiful. If brought out too early, they get covered with a layer of earthy deposit, or lose the roughness of their surface, and the spat will not then fix upon them; if brought out too late the spat may have altogether disappeared for that season. It is thus a very important question when and where to deposit the collecting tiles. Up to the present, oyster-culturists have been guided mostly by empirical notions, tradition and experience having decided what portions of the sea-bottom were most fertile for the collecting of the young. Theoretically this question is dependent on circumstances which are, indeed, complicated. It must first be asked, where are the oysters that furnish the spat? secondly, how long does this spat swim about independently, before fixing itself? thirdly, what is the influence of the currents in the vicinity of the mother oysters upon the distribution of the spat over a certain area?

It has been the object of a series of investigations planned by the Direction of the Dutch Zoological Station, of which I am a member, to try and get definite and reliable facts concerning these movements of the spat. I am sorry to say, that in this respect our results up to the present moment are rather scanty, although we are continuing our exertions. One fact is generally accepted, viz., that exceptionally good localities for spat collecting are those where there is a strong current of fresh sea-water at each tide in the immediate vicinity, and where,

at the same time, this current is broken by headlands or other causes, so as to produce counter-currents of much reduced intensity. The spots where these counter-currents occur are very much valued, as are also those deeper pits here and there found in the sea-bottom, above which a sort of whirlpool is apt to occur. It would seem that in both these cases, the spat is more easily deposited, is, so to say, precipitated, on the collecting-tiles or other substances (shells of dead molluscs, &c.), to which it can adhere. Localities answering to the above requirements are found on the spots I will indicate on the map.

In order now further to bring before your mind how the value of one locality above another for this and other purposes of oyster-culture, appears to be gradually established by experience, and is, indeed, recognized by those interested in this industry, I have promised to give you a few comparative numbers of the sums for which the same plots were leased in 1870, and will be so from 1885 forwards :—

Allotment No. 162, size 12 acres, was leased—

		In 1870 for 1s. 8d. a year ; will be in 1885 £202 a year.	
No. 163	12 ac. "	1s. 8d. "	£227 "
" 164	12 " "	13s. 4d. "	£252 "
" 176	12 " "	£22 10s. 0d. "	£508 "
" 220	120 " "	£25 18s. 0d. "	£33 15s. "
" 138	12 " "	£18 10s. 0d. "	£762 10s. "

Others have gradually come down in the market, as for example—

No. 280.	24 acres brought in 1877,	£45 16s. ; in 1879, £1 10s.
" 415.	18 " "	£2 1s. ; in 1882, 10d.

The fluctuation is, as you see, indeed considerable, and only rivalled by that mysterious fluctuation of spat which,

in the breeding season, is carried to and fro at each turning tide, all through the basin of the eastern Schelde.

A question which we were also eager to answer in continuing our investigations at the Zoological Station, was this: From whence is the spat that occurs in such myriads on the Schelde essentially derived? The interest of this question was increased by the fact, that among the oysters which were dredged on the cultivated beds, the number of ripe specimens carrying eggs, was very rare. This was partially explained by the fact, that the oysters are generally collected and sent into the market *before* the female generative products have attained their full maturity. However, this circumstance made it all the more wonderful that still the so-called *fall* of spat had, during the last ten years, been on the whole so considerable, the unproductive years being generally more the consequence of other circumstances than of the absence of young oyster larvæ at the right season.

It must, moreover, be specially mentioned, that after the Yerseke bed had been withdrawn from public fishing, no obligatory close time for oyster-fishing was ever prescribed. The lessees could dredge for their oysters at whatever time of the year they liked. That they did not generally do so in summer was, in the first place, for fear of disturbing the growth, the delicate edges of the shell being at this period more particularly liable to break; and secondly, because the oysters are found to be less palatable at this time of the year. I hardly presume that they were already convinced of the truth of Professor Huxley's view, which he repeated in his lecture above alluded to, and which I have no doubt is the right one, that a close time for fishing on oyster-beds may be very serviceable; but that there is absolutely no reason to see why it should be

more so *during* the spawning time than either *before* or *after*.

The great thing appears to be to leave a fair portion of the oysters on or around a natural bed, wholly undisturbed for a series of consecutive years. Now such an arrangement was never carried out *intentionally* on the Yerseke bed, every portion of it and of the whole eastern portion of the Oosterschelde having been leased for purposes of oyster-culture.

Continuing our investigations as to the source from whence the spat might be naturally derived, we were thus led to suppose that natural beds of a certain extent were present in the western portion further seaward. Dredgings were undertaken by means of a government steamer, but they gave a negative result, and this coincided with what had already been told us by fishermen, i.e., that no such natural beds existed.

One day, the idea occurred to us, that we were looking the wrong way, and that what we were searching for was much closer to us than we expected.

The fact is, and hitherto I have not yet mentioned it, that a regulation which has been rather strictly attended to, and which had originally been proposed by those government departments that are in charge of the maintenance of the dykes defending the country against invasions from the sea, runs thus: *it is not allowed to use dredging implements of any description for the capture of fish or mollusks within a line of 500 meters distance from the coast.* The reason of this prohibition was that the foot of the dykes running out into the sea is in several spots protected with specially constructed stone defences which might be seriously damaged by dredging, and might thus weaken the dykes, endanger the land behind them, and, at all events,



necessitate expensive repairs. It was the more easy to enforce this regulation because dredging for oysters within this 500 meter area, wherever the stone-works had been constructed, was attended with great danger of losing the dredge, as it easily got entangled in one way or the other.

Now to this band of nearly a quarter of a mile in width which surrounds the Schelde basin on all sides, our attention was more especially directed. A diver was sent down at numerous different points to make the explorations as thorough as possible. It was thus brought to light that really, wherever the stone-works alluded to stood out on the sea bottom, which at those localities rapidly sloped down towards deeper water, there was a more or less numerous, at some spots even a very profuse crop of oysters of all ages, which, in consequence of the regulations above mentioned, had never been disturbed and bore the evident traces of this. When at a few localities no oysters were found on the submarine stone-works it was to be ascribed to these having been newly constructed or repaired, or to their having been covered over with sediment.

The results of these diving operations were mapped out and are shown in the diagrams I have before me. The long band-like patches of oysters follow the stone-works, and both to seaward and towards the land, where a muddy bottom is prevalent in their immediate vicinity, no oysters occur.

The localities that have hitherto been thus investigated are shown in this map, and I may fairly infer that the continuation of our researches with the diving apparatus which are contemplated also in this summer, will enable us to trace the confines of this natural oyster-bed with precision.

It is hardly doubted by any of us, nor by the professional oyster-culturists themselves, who have a more

direct interest in the productivity of the eastern Schelde, that here, indeed, we have before us the principal source from whence the spat is yearly for the greater part derived, and everybody appears to be anxious to maintain the present state of things and to have the prohibitory clause against fishing within the 500 meter area most strictly observed.

The investigations concerning the oyster questions which were carried out by means of the transportable Zoological station, and which have just been alluded to, also extend in other directions. The anatomy of the oyster has been carefully inquired into by Dr. Hoek, and I have before me his elaborate treatise with numerous illustrations. The embryology of the oyster has been investigated by Dr. Horst, who is still continuing the researches, part of which are already published. The physical circumstances are similarly inquired into, and series of observations concerning temperature and salinity of the water are repeated three times a day at different points of the Schelde.

In the course of this summer our attention will be more especially directed to the process of fixation of the larvæ when at the end of their free life they settle down on some hard substance where to develop into a full grown oyster. To get hold of the largest number of young oysters, fixed in this way to transportable apparatus, is a most important object to all oyster-culturists, and this problem is before them once every year at the breeding season. All the different forms and shapes of collecting apparatus, some of which are here on the table, and which you will find in great variety in the different departments of this Exhibition, tend to the same object. Still the process of being obliged to bring these out into the open sea, hoping that the invisible spat may fix down upon them in great

quantities, may to a certain extent be compared to a man trying to catch birds by throwing his hat at a passing flock.

In order to bring this matter within the reach of man's voluntary interference, different attempts have been made to let the oyster give off its spat in an enclosed space where it might be collected at leisure on the apparatus which was deposited in the same enclosure. Such experiments have—in our country at least—always led to negative results. However, we are not certain that they were taken with the necessary precautions, the water being only very rarely and partially changed. The consequence of this must have been extensive mortality of the spat by the water becoming de-oxygenated, and loss of spat at those—whenever so few—occasions on which the water was partially renewed.

In our experiments we wish by all means to eliminate such sources of error. We have had the free disposition given to us, during the whole time of the experiment, of one of the largest oyster parks. It is represented in this figure. At these points there are inlets for the sea-water that can be opened and shut, and the volume of water forming the oyster park is divided by smaller dykes and by wooden enclosures into several compartments.

One of these has been entirely separated from the rest, and is specially devoted to the purpose of our experiments. In this separated portion, here indicated by dark blue, and which has a superficial extent of about a quarter of an acre, about 10,000 mature oysters are about to be deposited, the floor of the compartment having been covered by apparatus for collecting the spat. As long as the breeding season has not yet so far advanced that the spat is set free the water is changed with every tide. In the meantime

we have here put up a steam engine, and by this we intend to bring about artificial oxygenating of the sea-water the moment the spat makes its appearance. We then shut all the exterior inlets of water once for all and continue our experiments during the rest of the summer with the water at that moment contained in the park. In this way there is—1st, no possibility of the spat escaping. 2nd. No possibility of spat being introduced from outside, which would interfere with the reliability of eventual results.

To make a comparative experiment with different methods of aerating the sea-water we have divided the space here indicated in two halves. In the anterior portion a revolving axis with blades attached to it causes a continual current and at the same time introduces a certain amount of air. In the posterior portion compressed air is introduced into the water by a very large number of small orifices through which it is continually pumped, and from whence the air-bubbles must ascend towards the surface.

In this way we hope to provide our young oyster larvæ with a fair supply of oxygen, to the absence of which we ascribe the failure of previous experiments. Nobody can, of course, predict as to whether we shall be more successful, and whether in the breeding season we shall find the different sorts of collecting apparatus we are going to experiment with, profusely covered with spat ; but still it was our conviction that we ought to give the question a fair trial, the more so since the experiments of Bouchon Brandely on the French coast have put it beyond doubt that with the Portuguese oyster (*Ostrea angulata*), artificial fecundation and collection of the spat in myriads is quite feasible. The market value of the Portuguese oyster is, however, very low ; the oyster has quite a different shape

from ours, and is generally considered of a very inferior flavour.

This example, though encouraging, does not, however, admit of the conclusion that we have equal chances of success with *Ostrea edulis*, our north-European oyster. Part of the development of the young of the latter species takes place within the shell; and as this is not the case with the Portuguese oyster, artificial fecundation in the former species would be very hazardous.

For this reason the plan for the experiment has been traced in the way I have just now explained.

I have dwelt at some length upon these experiments because they will bring before your minds the phase at which the theoretical questions with which oyster-culture has to deal have at present arrived.

As to its practical side I am afraid time will not permit me to give you a fair description of the different imple-ments and processes. Moreover, I believe most of you are sufficiently acquainted with them; and if not, there is no such opportunity as that offered by this Exhibition to study them in full for yourself.

In terminating I must not omit to mention that the favourable results of oyster-culture in the Schelde have directed the attention of government to the re-stocking and the methodic improvement of the Zuyderzee beds on the same plan that has been followed since 1870 for the less over-fished Zeeland bed. As yet these measures are not far advanced, but it can hardly be doubted that in the course of a few years a new source of the prized delicacy we have been considering to-day will there be opened, the natural conditions having on the whole remained the same since the time these beds were so plentiful.

## DISCUSSION.

Mr. FELL WOODS said when the somewhat imperfect report of Professor Huxley's address at the Royal Institution was published he was impressed with some fear whether henceforth Professor Huxley must not be classed amongst the enemies of the oyster; but the inaugural address he had since delivered to this Conference somewhat re-assured him, because he had indicated plainly that there was a possibility that certain restrictions on oyster-dredging might produce some valuable results. Unfortunately he did not go so far as to say that they would actually produce such results, and so far as he restricted himself he was not quite sure that he had come over to the side of the oyster as against his enemies. He feared he did not place sufficient value on the close time during the spatting period. It was true, of course, that if a large amount of dredging went on during the other periods of the year the effect of the close time during the spatting period could not be so great as it otherwise would be; but in proportion as any oysters were left on the ground owing to the restrictions of close time so must the probability of an increase in the oysters be favoured. Some years since he (Mr. Fell Woods) showed that the period of spatting of the various oysters round the coast was not the same, and in any arrangement which might be made that fact ought to be borne in mind. There were certain periods applicable to certain oysters, and other oysters need not be interfered with during a portion of the period, but might be dredged, their close time coming at a somewhat later period. The restrictions which might be demanded beyond those of a close time were certainly of

very great importance ; they might be taken as including the question which attached on the one hand to beds within a three-mile limit, and on the other to those which were beyond that limit. But to some extent similar restrictions would need to be applied to both classes. They must apply to the age of the oysters at the time of their removal ; also to the parts of the oyster beds which were to be dredged from year to year ; to the removal of culch from those beds, and also possibly to the question of some license or fee to provide arrangements for watching and cleaning where required. It would be absolutely impossible on such an occasion to go into the details of this matter, but some years since he published a pamphlet, which he should be happy to submit to Professor Huxley and Professor Hubrecht, in which he had gone somewhat closely into these matters. The reply generally made to any demand for any regulation of oyster fisheries was that so far as concerned the public beds outside the three-mile limit, they would be interfered with by those countries with which we had no fishery convention ; but that argument merely showed that we ought to extend our fishery conventions to all neighbouring nations, and he believed that other nations were far more ready to adopt these restrictions than England was. Another matter which was constantly urged was the question of granting what were called "several" fisheries—the allotment of certain grounds to private parties, who undertook the custody and working of them, on a similar plan to that adopted in Holland. To effect this our present arrangements were scarcely what they ought to be, and measures more just to the neighbours should be provided in all these cases, and careful arrangements made with those who undertook them. Another deficiency was that nothing like proper protection against

poaching was provided. The wisdom of restrictions and regulations of course depended entirely on their character, and the burden of proof lay on those who advocated them ; but he could not help thinking the reference Professor Huxley made to what he thought was a comparative failure of the restrictive measures undertaken by the French Government, especially at Arcachon, left out of account a fact with which possibly he was not acquainted, viz., that when social or political circumstances appeared to demand it, the fisheries at Arcachon had not adhered to the regulations laid down, but permitted a considerable amount of dredging, in contravention of their regulations. The Paper they had just heard was certainly of the greatest value, and the fairness of spirit with which Professor Hubrecht had brought forward facts which might be used either favourably or adversely to Professor Huxley's view was most noticeable. From long experience of experiments somewhat allied to those now brought forward, he might say that Professor Hubrecht seemed in the main to corroborate views which he (Mr. Fell Woods) had printed some six or seven years ago. The most important point, in his view, was that any questions with regard to regulation and interference in oyster fisheries should be thoroughly discussed again before any decision was arrived at, either to neglect or interfere with them.

Captain ANSON remarked that Professor Hubrecht said these beds in Holland had suffered from over-fishing, and while of course he was willing to accept that, he should have been glad if a little further information on the subject had been given. He would also say that what was sauce for the goose was not sauce for the gander, and that if the oyster beds in the Thames or near the Mersey were allowed to remain undisturbed for two months they would be simply



ruined, mudded up and covered with ooze, and the oysters would all be eaten by crabs. He should also like to ask what was the depth of water on the Dutch beds, and also whether, as the result of his experiments, he could say the temperature altered the spatting. He believed that this matter had the greatest possible effect. He would mention one fact which perhaps tended to further the view that had been put forward, namely, that between Cancale and Grenville the French Government had established a permanent reserve, where no dredging was allowed. He went there dredging last year, and the oysters were certainly most numerous; they appeared to exist in millions. Another fact of some interest was this, that when making some new beds at a place called Arennes, the barriers between two of the beds broke down, and there was a small tramway that went out to the bed which was being constructed. It happened at the spatting season, and when the dyke was finished it was found that so many oysters had adhered to the rails, which had been constantly used by the tramway, that these rails were kept as oyster collectors, instead of being taken up to be used as rails. In Buckland's Museum would be seen a specimen of a flat iron covered with oysters, and, as Mr. Buckland remarked, when the oysters were in a sticking humour, they would stick to anything, and if the washerwoman who used the flat iron had been at the bottom of the sea, they would have stuck to her.

Capt. AUSTIN said he represented a large oyster company which had large beds at Whitstable, and also in Ireland and Scotland. He should second the suggestion of Mr. Fell Woods that there should be discussion on this oyster question, so that some practical conclusion might be arrived at. But as far as he gathered from Professor Hubrecht, he said it was nothing but the old oysters that

bred, whereas at Arcachon they dredged every old oyster off the ground, but would not allow the small oysters to be taken. With regard to close times he quite agreed with Professor Hubrecht that no kind of restrictions would do any good. A little fact was worth a good deal of theory. They had a large bed in Scotland where no oysters were dredged for five or six years, and a boat could go there and catch 2000 in a day, which any one would agree was a fair sprinkling of oysters, but there was no vestige of spat to be seen in the place of any sort. That was entirely contrary to the over-dredging theory. On the beds of Whitstable, which were about two miles square, there were from 25 to 30 millions of old oysters, but there had practically been no spat there since 1858 or 1859. There was a little, of course, every year, but nothing to speak of. If the over-dredging theory were right, why was there no spat there? Two years ago there was a large fall of spat, but, probably owing to the cold August, it disappeared and died off after getting to about the size of peas. In Ireland the Fishery Commissioners closed their beds absolutely for three years, but at the end of three years the fishermen could not catch as many oysters as they were catching when the beds were closed. The only fact that the over-dredging theory had to go upon was that the oysters were not there, and of course it might be said that if those which had been dredged had not been taken they would have remained. In his opinion there never would be cheaper oysters until there was a natural reproduction, and that would only come when the weather was favourable. With regard to breeding, he should like to have a little further information. With regard to artificial breeding in Holland, he was inclined to think that it was a loss to those who undertook it. At Arcachon he had asked several of the

great breeders, and they all told him that breeding oysters artificially did not pay. It paid individual fishermen who worked themselves, but it did not pay to breed on a large scale even at present prices. He thought the rents named in the paper were fancy prices, and should like to hear further particulars as to whether the matter was a commercial success, and he hoped there would be a further and more complete discussion on the whole question.

Mr. F. G. BROWNING (Whitstable) said that in the neighbourhood of Whitstable for the last 50, 60, or 80 years there had been more parent oysters than any person would think of stocking a new ground with, consequently it was not the want of parent oysters which caused the scarcity. But during the memory of man there had not been more than six or seven spatting seasons, and when there was abundance of spat it had been when the stock of parent oysters was reduced to the lowest ebb. He should also like to ask what was meant by ripe oysters carrying eggs, because he was under the impression that the spawn for all oysters was eggs.

The CHAIRMAN said they were all very much indebted to Professor Hubrecht for his very interesting Paper; but there were still several points left a little obscure, on which further light would be welcomed. Some of the remarks which had been made tended in some degree to a doubt as to the success of oyster-culture; but there was no doubt that beginning at Arcachon and finishing off in Holland, whatever were the methods adopted by the French, Belgians, or Dutch, they could claim at any rate the merit of success, for they had enormously re-stocked their ground and replenished their oyster-beds, and he could not think, that as regards climate, tides, and the possession of the estuaries on the coast, we were in such a totally different

position, that we could not with the greatest advantage, imitate some of the methods by which this success had been obtained. It seemed desirable to separate the question of regulation from that of cultivation. With regard to that of regulation, foreign governments possessed a great advantage over our own, they could do many things which we could not do, and which it would be impolitic on our part to attempt, unless thoroughly supported by the great fishing industries of the country. With regard to all these questions, the first thing to do was to impress on the minds of the fishing population the necessity for these regulations, and that if carried out, although they must be irksome for a time, they would be eventually for their benefit. It was also very desirable that there should be further discussion on this point ; but that hardly came within the scope of the present meeting. With regard to the cultivation of oysters, they had evidence of success in the quantity of breeding which took place on the coast of France, and he was rather surprised to hear from Captain Austin that it did not pay. He was aware that several companies had been established, and that a good many of them had been wound up, and therefore it was no doubt true that the smaller men had been the most successful commercially ; still, the nett result was a production of a great mass of oysters, large reserve beds were kept, on the idea that from them a great portion of the spat was produced ; but it must be remembered that the climatic resources of the country were considerable, and there was no doubt that owing to the higher temperature of the water at the critical period, oysters there had not the same difficulty to contend against as they had in England. In Holland, however, the climate could not be better than our own ; but he believed the spat fell much later in the year, towards the end of July or August,

and at that time, as he understood, the temperature of the water in the basin of the Scheldt would reach 70° Fah. If that were the case every year, it might have an important bearing on the production of oysters. He did not see that it could be the result of the climate; but it might be the result of currents of water—perhaps a portion of the Gulf Stream, which touched that part of the coast. The great advantage of the method pursued in Holland seemed to be this, that every year there was a fall of spat, filling the great basin which had been described, and the cultivators had nothing to do but to place their collectors above and below low water mark, in order to collect this natural floating spat. Now, it must be admitted that for many years past there had been no natural floating spat on the English oyster-beds at all. The question was, did that arise from the small stock of oysters, or was it entirely climatic? He could quite understand what had been said by Professor Hubrecht about the enormous advantage of leaving portions of the shore undisturbed where a large stock of oysters was maintained, and it was a well-known fact that the water near the shore was warmer than that further out. He had known the water in his river at Beaulieu from 75° to 78°, that temperature being produced by its water being so shallow. If, therefore, the breeding oyster lay within a short distance of the shore, he could perfectly understand that the warmth of the water would bring them forward to maturity, and thus this large quantity of spat might be derived. The breeding of oysters artificially in ponds had been tried in this country, and he had tried it himself; but whether from want of experience or carelessness, had not been successful in bringing any large quantity of the oysters which were bred to maturity. In 1878, he bred two ponds quite full of

oysters, probably eight to ten millions; but he believed from 25,000 to 30,000 was as many as were ultimately realised. He could not attribute that to any failure of the climate; but he believed it was due to inexperience and mismanagement. In 1880, a large quantity of oysters were bred in ponds at Newtown in the Isle of Wight, and certainly, up to the season of 1881, they were in a most excellent condition, and if they had been properly cared for must have been saved and brought to maturity; but other matters interfered which prevented their being so. He did not believe there was any great difficulty in breeding oysters in ponds in this country, except that they were really at the mercy of the climate, because in shallow ponds the changes of temperature were so rapid, that the passage of a hail-storm over it would utterly destroy the whole of the spat that would be falling there. He had never thought it necessary to aerate the water; but let it in and out every day with the tide. The state of the oyster when in embryo, would rather lead to the conclusion that in the day he naturally floated to the surface towards the warmth of the sun, and at night, when it was dark, sank to the ground, so that it was not difficult by an arrangement of upper and lower sluices, to arrange for a continual flow of fresh water into the ponds. The greatest difficulty of all in breeding oysters, was the uncertainty of the fecundity of the spat itself. He had seen ponds perfectly full of spat, with every prospect of coming to maturity, and then found in a short time that it had all disappeared. There was a good deal of truth in what had been said about the collectors. There was nothing to which oysters would adhere in greater quantities than a smooth piece of slate, so that actual roughness did not appear to be a necessity; what they heard most about, was perfect clean-

liness ; if anything grew on the collectors when the oyster-spat was forming, he was satisfied that the oyster would not fix on it, and finding the ground already covered by some other organism, it would die. That was one of the difficulties in pond culture, because the growth of seaweed itself in pools was much more rapid than in the sea, and if you were not fortunate enough to have the oyster-spat soon after the ponds were filled, the result was, that when they did spat, weeds were grown, and there was nothing for them to fix upon. Another great difficulty was the expense, and unless you could really secure a good fall of spat, it would not pay, unless you were fortunate enough to collect such a quantity in one year as would pay for several. The mortality in the oyster-spawn was one of the most remarkable features in the whole natural history of the oyster. The European oyster would produce over one million of eggs, and American oysters nearly five times as many, so that it was evident an enormous proportion must die. If by any knowledge they could acquire with regard to the regulation of the oyster fisheries, they could get a large reserve—not of course on muddy ground where they could not be left without moving—there seemed no physical difficulty in following the example of their friends in Holland, and collecting artificially the natural fall of the spat. If they took the area of the Solent or the mouth of the Thames, and thought of the enormous number of oysters which there ought to be in those districts, and how the tides must, owing to the natural eddies, flow backwards and forwards, one could hardly doubt that the spat might be collected, and it seemed to him that we might with advantage follow the system carried on there, and so do something to replenish our native beds. The British native oyster was the best that grew, though he was ready to give great

credit to the Dutch oysters, which probably came next to it but it was a great mistake for any one to suppose that by bringing a French or Dutch oyster, and putting it into English beds, that it was converted into a native.

The MARQUIS OF EXETER then moved a vote of thanks to Professor Hubrecht for his valuable paper.

HIS EXCELLENCY COUNT BYLANDT had much pleasure in seconding the motion. He was very glad that some gentlemen present had touched one important subject in regard to artificial oyster-culture, viz., the temperature of water, but unfortunately that was a fact beyond human control. It was different in different countries, and we must all submit to the consequences. Some doubt had been expressed as to the success of the artificial oyster beds in the Netherlands, but it seemed to him that that question must be left to those who were willing to pay every year increasing rents to the Treasury for the beds they leased, and as to the figures which had been given there could be no doubt. One gentleman touched on an interesting subject when he referred to the desirability of international convention with regard to fishing. No doubt that was a matter of great importance, but how it could apply to oyster fishing he was at some loss to understand, because if he was not much mistaken oyster-culture meant the creating of artificial beds which were generally established within the territorial waters of every country, and where he did not believe foreigners were allowed to fish. For all other purposes the mutual interest of all nations was guaranteed by conventions, and he was quite sure his country would be ready to join in any convention for that purpose. He was so much a layman in this matter that he did not dare to go into any further details, but he might tell the meeting a little story, which might amuse them, and certainly



puzzled him. The King of the Netherlands during his recent stay here reminded him that he had been appointed President of the Netherlands Committee, and therefore he should expect not only a lengthy report from him on the Exhibition, but also an essay on the possibility of getting fish without bones. He very much feared that even with the assistance of his friend Professor Hubrecht he should not be able to meet His Majesty's wishes except by sending him a specimen of the British oyster, which he believed was the only fish that answered the description.

The vote of thanks having been carried unanimously,

Professor HUBRECHT, in reply, said he might inform Count Bylandt that a fish without bones had already been found and was present in the Exhibition, but he regretted to say that its dimensions were so exceedingly small that it could never form an article of diet for the Royal table. With regard to the question Mr. Browning had brought forward as to the age at which the oyster produced eggs, he would remark that the eggs formed so to say the commencement of the spat, and only in a later stage of the development of the eggs, when they had been impregnated, they gradually changed into a state of larvæ, and these larvæ, which were afterwards set free in the sea water, formed what was called the spat of the oyster. The spat was nothing but the impregnated eggs, having become larvæ, swimming about freely a certain time, and afterwards fixing on to some object where they could grow into oysters. The age had been carefully investigated at which oysters produced eggs out of which spat could be evolved, and now it was quite clear that in the Scheldt only oysters of three or four years old contained such eggs. There was no instance of any oyster larvæ produced at an earlier age. The investiga-

tions of Dr. Hoek on this subject were published, and to them he would refer Mr. Browning. As to the question of certain oyster beds in Arcachon, as stated by Captain Austin, not having a vestige of spat, although there were a large number of mature oysters, he quite agreed with the possibility. The great question was, where had the spat that had been produced on this oyster bed gone to? As he had already stated, they did not know how long spat remained suspended, and it was generally believed that this might be three or four days, and thus the spat which had been set free out of the shells of the ripe oysters forming a given bed, might have been carried away by currents miles from the native place, and deposited elsewhere, or drifted away to sea without even growing to mature oysters. Next came the important point with respect to the "fall" of spat on the beds which were leased for the purpose. There was in all probability no region so favourable as the inland bay of the oyster Scheldt of which he had spoken. On many of the English beds situated on the coast, the moment the spat had been produced it might easily be carried away either to some distant point of the coast, or out to sea; but what happened in the Scheldt was somewhat different, and had been investigated very carefully. Each tide taking about six hours to ebb or flow, a floating object which also registered the deeper undercurrents—at least approximately—and which was set afloat above the oyster beds, had been carefully noticed at the beginning of the ebb. It of course went seawards; but it had not yet reached the ocean when the ebb was exhausted, and it was brought back again by the flood tide. It was greatly to this oscillating movement of a large bulk of water, which did not allow of the

spat being so easily carried out to sea, that in his opinion must be ascribed the fertility of this region as an oyster producing locality. He feared that if the arrangement contemplated were carried out, and they were going to have oyster beds established in the Zuyderzee, they would have greater difficulties to contend with similar to those from which England and France were suffering, and they would have to look out carefully for some spot which in that respect more nearly resembled the situation of the Scheldt. As to whether the artificial oyster-culture had been a success he could not deal with that point at length, Count Bylandt having already referred to the figures. In addition, he might say that whereas in 1870 the neighbourhood of these beds only consisted of very poor hamlets, at present they were most flourishing villages, and some of the old lessees who had from 1870 to 1885 held allotments there had re-invested their money in the new leases beginning in 1885. Fancy prices might have been given in individual cases, but on the whole the increase from £1,700 to £28,000 as yearly rent for the same 8,000 acres was perfectly genuine. With regard to the observation made by the Chairman as to the disappearance of the spat, he could well conceive that when the spat had been produced in enclosed parks great mortality was observed, so that no real results were obtained; it was to a great extent caused by the water not containing enough oxygen. He had been occupied to some extent with embryological researches on various marine animals, and he had found that if he only took care that a fair supply of oxygen were pumped into the water he could develop many marine forms of animal life, and keep them healthy for a period of eight weeks and longer, in no greater space than a large tumbler, without ever changing the water. With regard to tempera-

ture, it had always been observed that it was necessary for the water to be  $68^{\circ}$  or  $70^{\circ}$  in order to get a large number of spat on the tiles. He concluded by moving a vote of thanks to Lord Henry Scott, who had honoured him by presiding on this occasion.

The motion was seconded by Dr. DAV, and carried unanimously.